32. *Carpha nivicola.*

Rhizome creeping; stem very short, smooth; leaves and lower bracts broad-linear, blunt, with scabrous margin, flat towards the summit; spikelets one-flowered, fasciculate, greatly surpassed in length by the leaves; scales of the spikelets generally five, unequal, the outer ones twice or three times shorter than the rest; the innermost solitary, linear-setaceous, teethless, or wanting; bristles of the perigynium six, nearly to the top plumose, three times longer than the caryopsis; stamens three; style filiform, puberulous; stigmas three, capillary; caryopsis oblong-triangular.

On the highest summits of the Australian Alps, near swamps.

Closely allied to C. alpina. As a genus, I consider carpha as near allied to oreobolus as to cyathochate, rhynchospora or chætospora.

Gramineae.

Most of our new Alpine grasses are already published, but I avail myself of this opportunity to bring a kind of Ehrharta under notice, singular for its incomplete flowers.

33. *Ehrharta uniglumis.*

(Sect. Tetrarrhena.)

Stems branched, with the vaginæ and leaves scabrous, otherwise smooth; spikelets glabrous, distinct, perinath nerved, blunt; gimmella of the lower sterile flower a little longer than the solitary gluma, and as long as the hermaprodite flower.

In humid valleys on the Brodribb River.

It bears the greatest resemblance to Ehrharta (Tetrarrhena) contexta, but differs from this in the equal length of the sterile flowers, and like from all others in the want of the outer glume.

Art. XII.—*On the Failure of the Yan Yean Reservoir. Embracing an Examination of the Report of the Committee on the Yan Yean Scheme. By* David E. Wilkie. Esq., M.D.

Whether we regard the magnitude of the works now in progress at Yan Yean, for the supply of the City of Melbourne with water, or the great importance of the interests involved in the probable success or failure of this undertaking, the subject, I think, is one which merits the attention of the members of the Philosophical Society.

The gravitation system has, of late years, been very much adopted wherever it has been found practicable; because, although the first cost may be great, it possesses the advantage of a constant supply of water, at a high pressure, and at a comparatively small annual expenditure.

It becomes a matter of important calculation, therefore, in every case, to determine whether it is better, in a pecuniary point of view, to obtain river water in the immediate neighbourhood of a town by steam power, or to bring it from a distant and higher level by gravitation.

Accordingly, about six years ago, the late Mr. Blackburn, at that time City Surveyor, directed his attention to the problem of procuring water for the city by gravitation, and it is to that gentleman that we are indebted for pointing out the natural adaptation of Yan Yean for a large reservoir.

In recommending his favourite scheme to the public, there is no doubt that Mr. Blackburn had satisfied himself that there would be an ample supply of water for the reservoir. In his calculations, however, he placed great dependence on the natural advantages of the Yan Yean basin, in supplying a large supplemental amount of water from surface drainage, and in storing the flood water of the Plenty, independently of its ordinary discharge.

He also calculated that his gravitation scheme in 1851 would cost, including distribution pipes for the city, only 84,700*l.* to supply a population of 70,000, at 40 gallons per head per day; while the lowest cost for supplying the same population at the same rate by steam power, from the Yarra, he estimated at 76,700*l.* The annual current expenses attending the gravitation scheme, he estimated at 858*l.*, against 3,894*l.*, as the expenses attending the pumping scheme.

It must be regarded as a singular fact in the history of Melbourne, that with the river Yarra so easy of access, and so peculiarly adapted by nature to furnish an unlimited supply of the purest water, no steps were taken to supply this large city until February, 1853.

At that date, four Commissioners of Sewerage and Water Supply, were appointed under an Act of Council, and their engineer having reported very favourably of Mr. Blackburn's gravitation scheme, and having condemned all other plans for supplying the city from the Yarra, they determined forthwith to commence the works at Yan Yean.

I have always regretted the step taken by the Commissioners in adopting the Yan Yean scheme.

In the month of February, last year, I published a letter for the purpose of vindicating Professor Smith's preference of the Yarra scheme, and I endeavored to show that the Yarra water was necessarily purer than the Plenty water, and that the latter would be very much deteriorated by being transferred into the Yan Yean swamp, and, being there deprived of that constant and continuous motion which is its very life, that it would become incurably infected with microscopic animal and vegetable productions, which no filtration could remedy.

I described the plan adopted by the city of Edinburgh, which obtains its supply direct from the Crawley Springs, without subjecting the water to the injurious influences of exposure in a large open reservoir. And I urged the great advantage of possessing an unlimited supply of this necessary of life which the Plenty could not afford; and, as objections had been taken to all other Yarra schemes, on the ground of their impracticability, and the annual expenses attending them, I ventured to propose a simple scheme for bringing the Yarra water into Melbourne, on the gravitation principle, by means of a tunnel carried to the base of a shaft to be sunk alongside the Eastern Hill reservoir; which would thus have the effect of diminishing as far as possible the expense of pumping and management; and I showed that the annual expense of a pumping scheme for 100,000 inhabitants would cost a half-penny per week, per head; and that any expense was of trifling importance when the health and comfort of a populous city were involved.

I regret that I did not further prosecute my inquiries at that time, but the truth is that my letter having received no attention or sympathy in any quarter, I saw no prospect of warding off the evil which I believed to be impending over the city.

I still object to the Yan Yean scheme—1. Because of the enormous expense. In consequence of the discovery of the Gold-fields, labor is now at a much higher rate than when it was first projected by Mr. Blackburn. The Commissioners' estimate for the works is £650,000, of which £400,000 have already been expended; but it is the opinion of many that they will more probably cost £1,000,000. 2. Because the Commissioners, in erecting temporary works for supplying the city from the Yarra, have shown that, for the comparatively small sum of £30,000, the same object can, to a certain extent, be accomplished; and, indeed, if they had erected their temporary works at the right place, viz., near the junction of the Merri Creek with the Yarra, about a mile and a half from the reservoir at St. Peter's Church, the temporary works being distant half a mile from the same reservoir, and, so as to have avoided the surface drainage and sewerage of Collingwood and Richmond, we could have dispensed with the Yan Yean Water Works altogether. The expense of the additional horse-power required for the increased distance of one mile, which would be about six horses added to forty, and the saving in the carriage of coal, are trifling advantages to be purchased at a sacrifice of the public health, in a populous and wealthy city, which this measure really involves, as it has been clearly shown, by chemical analysis, that the water at Prince's Bridge contains four times more of impurities and matters prejudicial to health than the water at the junction of the Merri Creek with the Yarra.

But let us suppose that it would have been necessary to expend £60,000 in the erection of permanent works for raising water from the Yarra into the reservoir at St. Peter's Church, this would have been decidedly preferable as a commercial enterprise, when we contrast the interest of £60,000 at 10 per cent. with that of £600,000.

The Commissioners have thus altogether sacrificed the pecuniary interests of the public in their selection of the gravitation scheme, and have ignored the principle upon which a selection of either scheme is always based, namely, its adaptation to afford an ample supply of water at the lowest possible cost.

3. I object to the Commissioners' scheme because I do not think that in this climate a large swamp covering 7,000,000 square yards of surface is a suitable place for storing water for the consumption of a large city. It has been the natural receptacle for the surface drainage of the surrounding ranges, with only a very small natural outlet or water course. The consequence has been a vast accumulation of green slimy mud, the result of decaying organic matters, which will greatly alter and deteriorate the water of the Plenty, which, within its own banks, is exceedingly pure. And I find, on

referring to the able report of the Select Committee of the Legislative Council on Sewerage and Water Supply, that those gentlemen who were best qualified to give an opinion on the subject were unanimous in describing the deterioration which the water would undergo by being stored in the Yan Yean reservoir. The language used by one physician was that the water would be almost incurably contaminated; by another, that he should not like to use the water himself.

As regards the purity of the water, therefore, I think the Commissioners have disregarded the best interests of the public in a sanitary point of view.

4. I object to the choice of the Commissioners, because it was based on insufficient data. The Select Committee, in their report, say "our meteorological experience in these colonies by no means justifies the sanguine anticipations of Mr. Blackburn, who himself admits that a continued drought for two years, or even eight months, would render the whole scheme a failure;" and they state the following very grave objections to the reservoir scheme.

1. "That it would seem to be against all experience that any of the sources of the Plenty should be constant in all seasons.

2. "That sufficient allowance has not been made for the effect of evaporation over so large a surface as 1,200 acres, the proposed superficies of the reservoir."

And, while they were of opinion that the advantages upon the whole preponderated in favor of the gravitation scheme, they preferred to adopt the course taken by Mr. Hodgkinson in his evidence, and declined giving a positive opinion on the subject.

It is difficult to see what peculiar advantages the Select Committee had in view, without referring to the estimates of the two rival schemes which they were contrasting. The advantages which one scheme of water supply possesses over another, are always reducible to a money value.

The following are the estimates for the two schemes, which were under the consideration of the Select Committee in January, 1853.

	First Cost.	Annual Expense.
Modified Gravitation Scheme	£162,713	£1,450
Mr. Hodgkinson's Yarra Scheme	99,689	7,600

The objections which, in the opinion of the Select Committee, applied to Mr. Hodgkinson's plan, had reference exclusively to the annual expenditure for coal and supervision, amounting to £7,600. A singular objection, when it was admitted that the people of Melbourne had hitherto been compelled to pay at the rate of £150,000 a year for a miserable supply of water—£10,000 a year for a population of 100,000 is a halfpenny per week for each individual. If we add to this £10,000 as interest for the first cost of Mr. Hodgkinson's scheme, the cost of an efficient water supply from the Yarra, with all the advantages of purity, certainty, and high service, would have been a penny a week per head.

It is a singular fact, and worthy of being recorded, that the modified gravitation scheme, under the patronage of the Commissioners, so expanded itself in less than twelve months, as to re-appear under the new estimate of £650,000.

A good deal has been said of the advantages that the Yan Yean scheme possesses over its rival in its powers of indefinite extension. Perhaps this remarkable increase in the estimated cost is to be regarded as an illustration of this principle.

4. My chief objection to the Yan Yean scheme is the very limited supply of water for so colossal an undertaking, and this serious objection did not escape the notice of the Select Committee, who admit that it is "accompanied with the drawbacks that the quality and quantity of water might by possibility fall short of the standard, and that in the execution of the work some unforeseen difficulties might have to be encountered." And the chief object of this paper is to place before you certain data by which you may be enabled to judge for yourselves on this all-important point.

Having long entertained the opinion that the Plenty, from its limited size, was quite unsuited to supply the city with water, I resolved, in December last, to visit the Yan Yean Water Works, and obtain all the information I could respecting them. And as Dr. Mackenna had expressed himself much interested in the result of my inquiries, I invited him to accompany me, which he very kindly did. Mr. Taylor, the resident overseer of the works, politely showed us every attention, and gave us every information we desired.

It is proper here to mention, that when I submitted my first paper to you last month, it was necessarily based upon very limited data; but I was so impressed with the importance of the subject, and the result of my own inquiries, that I suggested the appointment of a Committee for the purpose of investigating the whole subject in a scientific manner, and reporting to the Society. I should also add, that I had the honour of accompanying your Committee on their scientific tour, and I shall not soon forget the pleasure and instruction it afforded me, and through their kindness in furnishing me with their measurements and calculations, I am enabled to submit to you this evening my opinions on the Yan Yean reservoir scheme, based on more correct data, and more extensive inquiry.

There is a considerable discrepancy in the published accounts of the amount of water consumed by different cities.

It appears that London and some other cities in England are supplied with 30 gallons per head per day, Glasgow is supplied with 30 gallons per head, by steam-power, Nottingham consumes 40 gallons per head, and the Croton aqueduct at New York is calculated to discharge 60,000,000 gallons in 24 hours, which for a population of 500,000 gives 120 gallons per head.

Great credit is due to the City Council for having from the first laid it down as a settled principle that Melbourne should be supplied at the rate of 40 gallons per head. At the same time I cannot regard this amount as adequate in a sanitary point of view to our actual requirements. Melbourne and New York are in similar latitudes, and considering the hot winds and dust storms, and the very dry atmosphere and long droughts that are peculiar to Australia, a more liberal supply of water would be required here than in New York.

For public baths and fountains, for thoroughly watering the streets, cleansing the gutters, and flushing the sewers, for extinguishing fires, and limiting their rapid and destructive progress, the water supply of this city should not be measured by so many gallons per head, the supply should at all times and under all circumstances be amply sufficient for any increased or unforeseen demand that might arise; but it will be shown in this inquiry that there is no such ample supply at Yan Yean to satisfy such luxurious anticipations, and we must be contented to limit our wants to the supply we can command. And in the event of a drought, to use the words of the Select Committee, "it is incontestible, that the most careful provisions would be necessary to guard against any unnecessary waste of water."

I shall, therefore, assume forty gallons per head as the amount that it will be necessary to provide for this city; and this is the amount upon which Mr. Blackburn and Mr. Hodgkinson based all their calculations, in their evidence before the Select Committee.

There is one important point in which I must differ from the Select Committee, and that is in limiting the amount of population to be provided for. Mr. Blackburn declined giving an opinion on this head, and I think the Select Committee were wrong in limiting the number to 100,000 for the modified gravitation scheme that was to cost 162,000*l.*, but they are in no way identified with the more costly scheme of the Commissioners. A gravitation scheme, involving an outlay of 650,000*l.* of public money should not be limited to any amount of population short of 500,000. In other words, it should not be commenced at all until an ample supply of water for 500,000 be secured.

The population of Melbourne, with its suburban towns and villages, is little short of 100,000; and the amount required for this number, at the rate of 40 gallons per head, per day, would be equal to 8,690,476 cubic yards. Now, as the area of the reservoir is 7,000,000 square yards, this amount of water would give a depth of 3 feet 8 inches in the reservoir, and a population of 500,000 would require a depth of 18 feet 4 inches.

Let us now inquire what amount of water can be supplied to the reservoir.

The main feature of the Yan Yean scheme is the large reservoir, or natural basin, which has an area of about 1450 acres, and a surface of about 7,000,000 square yards, and into which it is intended to direct the greater part, if not the whole of the watershed of the Plenty basin.

For this purpose an aqueduct of about two miles in length is being now formed to lead the river into the reservoir, and a large embankment is being raised at the lower end to the height of thirty feet; and, as it is expected that the river will more than fill the reservoir, and that it will maintain a current through it, there is a waste wash at the height of twenty-five feet to lead back the surplus water to the Plenty. A tower well has also been erected within the embankment, and is so arranged as to admit the water into the main pipes by two openings, at ten and seventeen feet, from the bottom of the reservoir. The third opening at the bottom of the tower well, as explained by Mr. Taylor, is only intended to draw off the impurities that will be deposited from the water.

The Plenty takes its rise in Mount Disappointment by two main branches, the eastern and the western. The latter, according to Mr. Hodgkinson, takes its source from a considerable stream which gushes direct from a fissure in the granite. The eastern branch, as we had lately an opportunity of witnessing, takes its rise from the table land at the very top of the mountain, and, from the smallest possible beginning, is gradually augmented by innumerable rills and streams issuing from the moist rotten soil and from the fissures and crevices of the rocks. Both branches, at the base of the mountain are discharged into large swamps; and it is not until they issue again from these that they unite to form the Plenty River, about four miles from Yan Yean. The area of the western swamp, according to the estimates of your Committee, is 787,000 square yards, that of the eastern, 3,808,000 square yards.

These streams have been measured at different times and under different circumstances, with the following results.

The late Mr. Blackburn, in his first report on the water supply of Melbourne, dated 9th January, 1851, states that he had measured two of the branches of the Plenty, above the marshes, and found them to discharge respectively 2,000 and 1,700 gallons per minute, and he estimated that the whole discharge of the tributaries amounted to 5,000 gallons per minute, which is equal to 6 feet 7 inches in the reservoir, while the united stream below the marshes scarcely gave 2,700 gallons per minute, or 3 feet 7 inches. There was thus a loss by evaporation of 2,300 gallons per minute, which would give 3 feet in the reservoir, in twelve months.

There being an unusual drought in the summer of 1851, Mr. Blackburn, on two separate occasions, revised his former measurements; on the latter occasion, the 14th February, he found the discharge of all streams above the swamps amount to 4,040 gallons per minute, which equals 5 feet 4 inches in the reservoir, and in the river below the swamps he found only 865 gallons per minute, or at the rate of 1 foot 1 inch in the reservoir, showing a loss by evaporation of 3,175 gallons per minute, which would give 4 feet $1\frac{1}{2}$ inch in the reservoir.

Mr. Hodgkinson, on the 9th December, 1852, after fifteen hours' rain, measured the western arm, where it issues from the granite rock, and estimated the discharge at 1,180 gallons per minute, or 1 foot 7 inches in the reservoir; he also measured the same stream, where it enters the swamps, and found it to give 1,700 gallons per minute, or 2 feet 3 inches. On the following day he measured the eastern arm, below the first waterfall, and found it to discharge 1,980 gallons per minute, or at the rate of 2 feet $7\frac{1}{2}$ inches in the reservoir.

The first of Mr. Hodgkinson's measurements is the one of most value in this inquiry, as we may presume that the stream, where it issued from the rocks, was little affected by the previous rain. The second measurement was taken at a situation where it could not fail to be considerably augmented by the rainfall of fifteen hours. The measurement of the eastern arm, which was obtained the following day, could not give any certain result, as it was taken above the junction of three small tributaries. In one point of view, however, it is very important, as the object of the measurement was to illustrate the constancy of the supply. All the other tributaries of the Plenty have been known to fail on several occasions.

The measurement of the main eastern branch, therefore, shows an approximation to the amount of water supply that would be available above the swamps in a severe drought, but it is only an approximation, as it too may also fail; there is certainly no guarantee in the height of Mount Disappointment, which is only 1,500 feet, to warrant a more favourable opinion.

All the tributaries of the Plenty equally depend on the rainfall of the mountain ranges, and it is simply because the main eastern branch rises from the highest point, where there is most rain and least evaporation, that it holds out the longest when the ordinary supply of rain is cut off.

I come now to mention the measurements which were made by the Committee who were appointed to investigate this subject at the last meeting of the society.

The river, at its junction with the aqueduct, with a velocity of half a mile an hour, gave a discharge of 2,537 gallons per minute, or an equivalent to three feet four inches in the reservoir. The eastern arm above the swamps yielded 4,450 gallons per minute, or an equivalent to five feet eleven inches. If we take Mr. Hodgkinson's measurement of the western arm, where it issues from the rocks, namely, 1,180 gallons per minute, and add to it the Committee's measurement of the eastern arm, we shall have 5,630 gallons as the discharge of all the streams above the swamps; and if we take into consideration that one week before their visit to Yan Yean there were nearly three days of heavy rain, which is an unprecedented occurrence in January, the 630 gallons may be regarded as due to this source, and the balance of 5,000 gallons per minute will exactly correspond with Mr. Blackburn's estimate.

From these measurements, it would also appear that the eastern arm bears the proportion to the western arm of 4,450 to 1,180, or very nearly four to one. By this estimate we shall find that the discharge of the western arm was 1,340 gallons per minute, at the time when the committee measured the eastern arm. The whole discharge above the swamps was therefore 5,790 gallons per minute, and below the swamps 2,537 gallons.

In this manner we ascertain that the loss by evaporation in the swamps amounted to 3,253 gallons per minute, which is at the rate of 4 feet 4 inches in the reservoir; and as the area of the swamps is one half less than the area of the reservoir, 8 feet 8 inches will represent the rate of evaporation in the swamps during the summer months.

It is thus easy to understand why Mr. Blackburn and Mr. Hodgkinson so strongly urged the necessity of making artificial watercourses, in order to withdraw the two branches of the river from the influence of the swamps.

It does not appear that the Commissioners of Sewerage and Water Supply have any present intention of doing this, and I am not sufficiently acquainted with the levels and depths of the swamps to give any opinion as to the best mode, but it is quite clear that some steps must be taken to save the immense loss that is at present occasioned by them. And in estimating the quantity of water that will be available for the reservoir I shall assume that some effectual means will be adopted to accomplish this very desirable object, and that the whole of the 5,000 gallons may be transferred into the reservoir without loss.

The measurements would not be complete without mentioning, that Dr. Mackenna and myself, on our visit to Yan Yean, measured the Plenty where it passes under the bridge, about three miles below the reservoir, and obtained a discharge of 960 gallons per minute, which would give a depth in the reservoir of 1 foot 3 inches. The measurement of the committee at the same place, on their late visit, gave 475 gallons per minute, which is equal to 8 inches in 12 months.

These small results compared with the measurement above Yan Yean arise from the quantity of water that is abstracted by a cut for the purpose of puddling the embankment.

I have thus assumed Mr. Blackburn's highest estimate of 5,000 gallons per minute as the average of the whole discharge of the tributaries of the Plenty. In the drought of the summer of 1851, however, Mr. Blackburn found this amount reduced to 4,040 gallons; and therefore it is to be presumed that 5,000 gallons are only to be depended on in ordinary seasons.

The important question now arises, what proportion of the 5,000 gallons can be abstracted from the river without inflicting serious or irreparable injury upon the inhabitants of the district through which the Plenty takes its course. One witness, who was examined before the Select Committee, gravely proposed that a half-inch pipe from the reservoir should be given to the inhabitants on the banks, in lieu of the river itself; but to be serious, I am most decidedly of opinion that it would inflict irreparable injury upon the inhabitants of the Plenty district to abstract more than two-thirds of their river from them. Even with this loss they will suffer enough in the permanent closing of all the mills; and I have no hesitation in saying that the good sense of the public of Melbourne would neither expect nor demand more. If the Yan Yean scheme cannot afford to do this it had better be abandoned at once. Nor do I think that the public interests would suffer much thereby.

In ordinary seasons, as already shown, the discharge of the Plenty above Yan Yean, is 2700 gallons per minute in December, and deducting one-third there will remain 1800 gallons, or an equivalent to 2 feet 5 inches; this, added to 2300 gallons, which is the amount at present lost in the swamps, but which I take for granted will be saved, gives 4100 gallons per minute as the average amount of water available from the river for the supply of the reservoir, and this will give a depth of 5 feet 6 inches.

It is more difficult to calculate the amount that might be obtained from the river in time of floods, from the uncertainty of their occurrence, volume, and duration. Had the reservoir been in close proximity to the river, with a sufficient fall, a large amount of flood water might easily have been secured; but in order to obtain 25 feet of depth for the reservoir, it is necessary to bring in the river from a higher level by means of an aqueduct of about 2 miles in length, which winds round the base of the range which separates the river from the reservoir, and which will enter the latter by a tunnel which is being cut through this dividing range. Unless, therefore, a very strong embankment be constructed for the purpose of damming the flood water, which would be a very difficult and expensive operation, owing to the level character of the right or opposite bank, it is difficult to see how the floods can be taken advantage of to any great extent. On such occasions the water is widely extended over a large surface, and will naturally prefer the lower level of the river to the higher level of the canal or aqueduct.

Assuming, however, that the aqueduct can be filled from the river in time of floods, and assuming that the Plenty will be in a flooded condition for 60 hours in each year, the sectional area of the aqueduct, which is 127 feet, with a velocity of one mile per hour, will give 1,494,000 cubic yards, which would add a depth of seven and a-half inches to the reservoir, or at the rate of 3 inches each day. This result, however, could only be obtained with a dam, so constructed as to raise the surface of the flood water to the height of eight feet above the present level of the river, and at the entrance of the aqueduct the right bank is only one and a-half feet above this level.

In order to do every justice to the resources of the Yan Yean reservoir, I think, that during the three winter months, we may assume that the river is larger than in the summer months, during which season the above measurements have been all made; and I shall take this opportunity of urging how important it would have been to have had accurate measurements of all the tributaries of the Plenty for each month of the year. As there is one-third more rain in the winter months, I propose to allow two-thirds more watershed, independent of floods. This will be equal to one-sixth of 5,000 gallons per minute, or its equivalent, six feet seven inches, which will give an addition of one foot one inch to the reservoir.

It may appear to some that I have allowed too little for floods. It may be thought that sixty hours will not accurately represent their duratiion for twelve months. It must be remembered, however, that the entrance of the aqueduct is only eight miles from the source of the eastern or main branch of the Plenty. With such a short and limited watercourse, therefore, in a few hours after any heavy fall of rain, the river will have returned within its own banks. It must also be remembered that we may possibly have no floods at all in twelve months; and I feel quite certain that in the last twelve months the river has not been flooded for more than twelve hours at Yan Yean.

As a source of supply for the reservoir, the next in importance is the annual fall of rain. The meteorological tables which have been kept in Melbourne for a period of six years, give thirty inches as the fall of rain for twelve months, and eighteen inches for the six winter months; but as Yan Yean is 600 feet above the level of the sea, I propose to allow six inches on that account, and, therefore, thirty-six inches or three feet, may be set down as an addition to the reservoir from this source, and in the same proportion twenty-two inches represent the rainfall for the six winter months.

Having ascertained the rainfall of the Plenty basin it would be of great importance to determine the whole amount of the watershed. The only certain method of obtaining this result would be to take accurate measurements of all the tributaries, at least once in each month, and to make a careful survey of the floods that may occur during the year.

In the absence of such measurements it becomes important to estimate the amount from data that are recognised in England, making due allowance for the difference in the mean temperature, and the physical peculiarities of the drainage area.

If we could ascertain the amount of rain in any district, and the proportion of the rain that is evaporated from the surface of the ground, the difference would exactly equal the contents of the rivers.

On this principle, the late Dr. Thomson, the Professor of Chemistry in the University of Glasgow, estimated the watershed of Great Britain at four inches of the rainfall.

From the meteorological tables he calculated the rain, including four inches of dew at thirty-six inches, and from experiments and observations he calculated the amount of evaporation from the ground at thirty-two inches. He therefore computed the watershed at four inches, or one-ninth part of the rain.

Although Dr. Thomson considered his estimate of four inches too high, from a calculation which he made of the the contents of the river Clyde, compared with its drainage area, yet it differs so greatly from other estimates, which are as high as eleven and thirteen inches, that the only inference we can draw is that the whole subject is still enveloped in so much obscurity and uncertainty, that no correct practical results can be obtained by this method.

It would, therefore, be altogether a visionary speculation, to make the water supply of a large city depend upon the correctness of either of the higher estimates. It would be unworthy of modern engineering science, and could only lead to failure and disappointment.

The most correct view of the subject is probably that entertained by Dr. Prout, who thinks that the truth lies somewhere between the extremes, and I therefore feel disposed to determine the watershed of England, in accordance with the experiments of Messrs. Hoyle and Dalton, who found, with a mean rain of 33.55 inches for three years, that the evaporation from the ground equalled 25·14 inches; therefore 8·41 inches, or one-fourth of the rain, may be presumed as the amount available for springs and rivers in England.

I am not aware that any experiments have yet been conducted in this colony to determine the proportion of the rain that is evaporated.

The physical character of the country, however, shows that there are comparatively few rivers, and that these are very scantily supplied with water, and that floods are not of frequent or regular occurrence. The absence of high mountains, and the arid and desert condition of the interior, while they greatly diminish the rainfall, contribute to render the atmosphere peculiarly dry, and evaporation very rapid.

In the summer months many rivers and creeks are dried up, and the ground becomes so parched that it is capable of quickly absorbing a large quantity of rain, so that it is rare to find rivers much increased during this season, and the watershed is very trifling indeed.

I think, therefore, that with nearly the same amount of rain as in England, and with a much smaller proportion of rivers and fewer floods, there must be a much larger proportion of rain evaporated from the surface.

I may thus, on very strong grounds, assume that the watershed in this colony is one half less in proportion than in England, and therefore amounts very nearly to Dr. Thomson's estimate, which is one-ninth of the rain.

But it is more satisfactory, and certainly more correct, to deduce the watershed of this colony, from that of England, by making adequate allowance for the difference in the force of evaporation due to our higher mean temperature; and, as it is admitted by scientific men here, that the evaporation from the surface of water is nearly double that of England, it is strictly correct to assume that the proportion of rain evaporated here will also be nearly double.

Thus, I think, no valid objections can be offered to my assuming four and a-half inches instead of eight and a-half, as the best approximation that can be made of the watershed of this colony, until the mean discharge of the different rivers is ascertained by actual measurement.

In mountainous districts the watershed is greater in proportion than in the low country, and the absorption and evaporation less; and therefore it might be thought that Dr.

Thomson's estimate cannot apply to the Plenty Ranges, but their geological formation, and the tropical vegetation with which they are covered, are singularly adapted to absorb and retain a large proportion of the rain that would otherwise flow direct into the watercourses; and it is to this beneficent provision of nature in this dry climate that all the rivers that take their rise in the primary and granitic formations owe their permanency, and not to springs of the ordinary kind, that are met with in the secondary and tertiary formations, which are almost entirely absent; and were it not for this provision the river Plenty, and other similar streams, would cease to flow altogether in the summer months. The winter rain which is now stored up in the spongy soil, and in the caverns and fissures of the rock, maintains a more or less constant stream during the whole summer, and it is in this manner that we explain the otherwise singular fact, that the river Plenty is so little increased in size, during the winter months, in ordinary seasons. In my estimate of the discharge of the the river I have allowed an increase of two-thirds.

But it is not to be supposed that the water thus stored is altogether removed from the influence of evaporation. On the contrary, from its universal tendency to find a lower level it is constantly oozing out over the whole surface of the ranges, and leading gullies, which is thus always in a wet condition, and always evaporating, and the surface is so wet even near the summit, that we found abundance of small leeches several hundred yards from the stream.

The watershed of the Plenty ranges, therefore, differs essentially from the watershed of ordinary mountainous country, and thus the evaporation from the ranges is, probably, fully equal to that from the plains, because while evaporation from the level country is one-third more rapid than from the ranges, it ceases nearly altogether for three months in the former, while in the latter it is constant throughout the year.

The drainage area of the river above the aqueduct, according to the Survey Maps, may be computed at about sixty square miles. The ratio of this surface to the surface of the reservoir is as 26 to 1, therefore the whole rainfall, including four inches of dew, would give a depth of eighty-eight feet in the reservoir, and one-ninth part of this, or nine feet nine inches, would give the watershed.

It may be interesting here to contrast the whole discharge of the Plenty, as I have already estimated it, with the whole amount of the watershed as deducible by Dr. Thomson's method.

	Ft.	In.
5,000 gallons per minute -	6	7
60 hours' floods - -	0	7½
Two-thirds increase in winter months	1	1
Total - -	8	3½
Whole watershed - -	9	9
Balance unaccounted for	1	5½

The only other important source of supply is the drainage area of the reservoir itself. Mr. Hodgkinson was kind enough to measure this area for your committee, and his estimate is 3,000 acres, or about twice the surface of the reservoir.

During the winter months there has generally been more or less water in the reservoir; but during the summer it has almost always been quite dry.

In 1851 there was no water in it during the whole year; and this fact is not only important as regards the watershed of the reservoir, but it has a far more extensive and significant importance as regards the watershed of the Plenty. I have estimated the rainfall for the basin of the Plenty at thirty-six inches; but in 1851 there was so little rain in that district, that even during the winter months no water was collected in the reservoir, from a drainage area, including the reservoir, of nearly seven square miles, or one-eighth part of the drainage area of the Plenty.

It can hardly therefore be alleged that I have under-rated the average watershed of the Plenty.

After heavy rains and floods, the reservoir has sometimes had as much as two feet of water at the lower end, and then it overflows into a small watercourse or rather swamp, which skirts the ranges for about two miles, and then enters the river by a creek, which has a sectional area of about twelve feet. At the upper end, the reservoir receives a larger creek, which has a length of about three miles, and contains a large quantity of water after heavy rains; but when there is no rain it is quite dry.

According to the best information which I have received the reservoir has, on an average, been dry for six months in the year, evaporation, therefore, must be constant during the six winter months; now from other data we can estimate the amount of water thus evaporated, which is equal to two feet five inches, and the rainfall, for the same period, is twenty-two inches, leaving a balance of seven inches to represent the surface drainage that is evaporated. If the watershed, therefore, exceeds seven inches it must escape by the small creek at the lower end, and may be approximately ascertained. This watercourse has been generally observed to run after heavy rain, but not otherwise. If, therefore, we assume that there are, during the winter months forty days of heavy rain, and that the creek is, on an average, half full, and that its velocity is about half a mile per hour, the contents would amount to 1,900,800 cubic yards, which would give seven inches in the reservoir. By this estimate the water shed cannot exceed fourteen inches.

It is important, also, in this enquiry, to estimate the watershed according to Dr. Thomson's method. The ratio of the drainage area to the reservoir being as two to one, the whole rainfall would give a depth of six feet, and one-ninth would give a watershed of eight inches; but as there is no watershed in the six summer months, and as the rainfall of these months is less than that of the winter months, in the proportion of two to three, the rainfall of the drainage area must be taken at three feet seven inches for the winter months; and as the area is chiefly composed of ranges of clay slate, which are much less favourable for absorption than the level country, three-ninths or one-third instead of one-ninth of the rainfall may be estimated as the watershed, and this will give fourteen inches, which exactly corresponds with the former estimate.

I shall here notice some considerations which would seem to prove the correctness of Dr. Thomson's estimate, in its application to the basin of the Plenty.

Mr. Blackburn's highest estimate of all the tributaries is 5,000 gallons per minute, or 6 feet 7 inches in the reservoir. One half of this amount, therefore, or 3 feet $3\frac{1}{2}$ inches, will represent the absolute quantity of the watershed for the six summer months. Now, as there is one-third less rain, two-fifths of 88 feet, or 33 feet in the reservoir, will represent the whole of the rainfall for this period. Therefore, the watershed is equal to one-tenth of the rainfall, and the remaining nine-tenths are evaporated.

In the six winter months there is one-third more rain, and, therefore, there will be one-third more water shed; but evaporation is also one-third less rapid, so that if we add two-thirds to Mr. Blackburn's estimate for the six winter months, we shall have the water shed for that period. To 3 feet 3½ inches add 2 feet 2⅓ inches, which give 5 feet 6 inches. Now, 55 feet represent the whole rainfall for the six winter months; therefore, 55 divided by 5½, or one-tenth of the rain, gives the whole watershed.

This result may be regarded as a near approximation in ordinary seasons, with no heavy falls of rain, but on such occasions, there is too little time for absorption, and a much larger proportion of the rainfall is quickly conveyed to the rivers. But most people have very exaggerated notions respecting floods, and many people fancy that one flood would fill the Yan Yean reservoir, if it could be secured.

The following considerations will show the very small proportion of the rainfall that can be contained in any ordinary flood.

The velocity of the river, at its junction with the aqueduct, is half a mile per hour, and its present discharge gives 3 feet 4 inches in 12 months; therefore, 88 feet, or the whole rain fall of one year, would require 26 years to pass down the river. The aqueduct has 9½ times the sectional area of the river, yet with this volume and the same velocity, the whole rainfall would require 985 days, or more than 2½ years to be conveyed into the reservoir, while such floods as would fill the aqueduct, do not last more than 2 or 3 days.

The mean rainfall of the different months here is 2½ inches, which can readily be disposed of by absorption and evaporation in mild seasons. The highest mean rainfall is four and one-fourth inches; and in November, 1849, there was a fall of twelve inches, in consequence of which we had a very high flood in the Yarra, which lasted about a week.

I possess no information with regard to the duration of the flood in the Plenty at Yan Yean, but with so short and limited a watercourse, I consider it impossible that the river could have been flooded at that time for more than three days. The sectional area of the highest flood line, as determined by your committee, is 200 feet. Now, with a velocity of two and one-half miles per hour, which is the velocity adopted by them, three days or seventy-two hours would give a discharge of 7,040,000 cubic yards, which is equal to three feet in the reservoir, or one foot per day; and such a flood as that of November, 1849, probably does not occur more than once in ten years.

But how could such a flood be secured for the reservoir? The same amount of water would take twelve days to pass through the aqueduct at one mile an hour, which is the highest velocity that it would be either safe or prudent to allow. A higher than this, in such a winding canal cut out of the clay-slate, would convert the water into mud, and break up the sides, and wash away the artificial banks; and for the sake of such a flood, which may possibly occur once in ten years, would it be reasonable to spend £30,000 in enlarging the aqueduct to four times its present size? and without suitable embankments raised at an enormous cost, to dam up such a flood, one half would not enter the aqueduct at all.

As twelve inches of rain fell during the month, instead of four, we may safely conclude that this flood resulted from a rainfall of at least six inches, which would give thirteen feet in the reservoir, so that out of thirteen feet of rainfall in one of the heaviest floods on record, only three feet reach the rivers, or less than one-fourth.

The only other source of supply to be noticed is dew. In England from four to five inches have been computed as the amount of dew deposited on the ground, but I am not aware of any experiments to show the amount deposited on water. I feel persuaded that the atmosphere is generally so dry here, that the amount of dew must be very small; and unless in the case of very shallow pools and lakes, there can be very little deposited on water. A depth of two or three feet will, in a great measure, prevent the formation of dew, because as the upper particles become cooled they at the same time descend, from their increased density, to make way for the warmer and lighter particles underneath, and until the whole depth of water has attained a considerably lower temperature than the atmosphere with which it is in contact, no deposition of dew can take place.

As it is possible that there may be some dew, when there is very little water in the reservoir, I shall on this account allow an increase of two inches for the whole surface, which is equal to sixteen and one-half days supply for the city.

The whole amount will stand thus:—

	ft.	in.
From the River Plenty	5	6
Floods in ditto	0	7½
Increase from winter rain	1	1
Rainfall in reservoir	3	0
Drainage area of ditto	1	2
Dew	0	2
Total amount	11	6½

I come next to determine the amount of loss from evaporation and absorption.

In large reservoirs the annual evaporation from the surface is a very important element to be considered, and, as it increases nearly in a geometrical ratio, with an arithmetical increase of temperature, a comparatively small difference in the mean temperature might give double the amount of evaporation. It is therefore especially important in warm climates that its actual amount should be ascertained by a careful series of experiments, before any work of magnitude is undertaken, whose success or failure might entirely depend on the result.

In my first paper, which I only regarded as a preliminary inquiry, I computed the evaporation for this colony from the tables of Dr. Dalton, who gives forty-four inches as the evaporation for England. I took the mean temperature of the different months in Melbourne, and assumed for each month the amount of evaporation corresponding to the month of the same mean temperature in England. I also estimated the increased evaporation proportionate to the increased mean temperature and to hot winds, to which I allowed a mean temperature of 87°, and a duration of fifteen days, and I thus determined the evaporation to be seventy-two inches or six feet. I stated, however, that I felt satisfied that a careful series of experiments would show a still higher result, as, independent altogether of the temperature, the much drier condition of the atmosphere in Australia exercises a powerful influence in promoting evaporation.

Since our last meeting I have ascertained that Mr. Glaisher, who is the highest authority on meteorological subjects, has estimated the evaporation at Greenwich at sixty inches, or five feet annually. Proceeding upon this higher estimate, the evaporation, calculated in the same way, would be equal to eight feet two inches; and, making due allowance for the dry condition of the atmosphere, nine feet may be safely assumed as the mean evaporation for this colony.

I have also learned that Dr. Davey, a member of this Society, has devoted a great deal of attention to this subject, and he has furnished me with the result of his experiments. He is quite confident that the mean evaporation is not under nine feet, but he is inclined to believe that it is more probably ten feet. This summer having been remarkably cool, with a great deal of rain, and few hot winds, is not to be regarded as an average season.

Being anxious to ascertain the rate of evaporation over a large surface, fully exposed to the influences of the weather, I lately selected a sheet of water of about 300 yards long, with an average depth of eighteen inches, and width of fourteen feet, and, by fixing a mark in a particular part of the bank, I made careful measurements several times during fourteen days, and found that the amount lost exactly equalled six inches in that time, which gives five lines per day, and, for the three summer months, three feet two inches. The weather throughout was cool, excepting one day, and the winds southerly and easterly, so that this may be regarded as the lowest rate at this season. By computing the evaporation of the other months according to their mean temperature, this rate would give nine feet for the twelve months.

In further illustration of this subject, I may mention that Mr. Laidlaw has computed the evaporation in Calcutta at fifteen feet, and he also found that it averaged nearly three-fourths of an inch a day, between the Cape of Good Hope and Calcutta, and between 10° and 20° in the Bay of Bengal, he found it to exceed one inch daily, or at the rate of thirty feet in the year.

Dr. Milner mentions that there are many lakes in the steppes of Northern Asia which have no natural outlet. Some of them are many miles in circumference, and have a depth of six and seven feet, from the winter rain, but are entirely evaporated during the summer months.

And, according to Irby and Mangles, who describe the effects of evaporation in the Dead Sea, it must be very rapid indeed, notwithstanding the strong saline impregnation of the water. During the rainy season, the increase of the Jordan and other streams is sufficient to raise the level ten or even fifteen feet; but under the influence of a burning sun and a dry atmosphere, the lake, in a few months, resumes its former level.

It remains to consider the loss from absorption.

At the last meeting of the Society I expressed great fears that a serious loss might be sustained in the reservoir from this cause; but I have since seen the evidence which Mr. Hodgkinson gave on the subject before the Select Committee, which I consider perfectly satisfactory.

To determine the exact amount of water, that will be available for the use of the city, I have now to deduct the loss from evaporation.

Total - - - - -	11 ft.	6½ in.
Deduct evaporation - - - -	9	0
Balance - - - - -	2	6½
Required for present wants - - -	3	8
Balance deficiency - - - -	1	1½

This is indeed an unfortunate result of the gigantic operations and large expenditure already incurred at Yan Yean. And it seems not a little extraordinary that such unlimited confidence should have been placed in the abundant supply of water; and it is no less extraordinary that Mr. Blackburn, with a knowledge of the immense loss sustained from evaporation in the marshes, should have urged the necessity of rescuing the river from this slough of despond only to plunge it into an abyss of greater magnitude, where it would be scattered, contaminated and rapidly dissipated.

But it will probably be said, that as I have only shown a deficiency of one foot and one and a half inches, which is rather less than one third of the amount required, I may be in error in my estimate, and perhaps the winter rains may furnish the amount. Now, I shall admit that in some seasons even double this amount may possibly be added to the reservoir from this source, but I do not thiuk that this need be regarded as a subject of congratulation. With a stream of pure water, encircling this city like a horse shoe, the inhabitants will not willingly pay £650,000 to be subjected to the chances of the seasons, to be dependent on the casualities of rain for the first necessary of existence; and, if we must speculate on chances, how often do we have summers remarkable for droughts, and the prevalence of hot winds? And, what we gain by casualties of rain, we shall certainly lose by the casualties of evaporation. An inch a day, for hot winds, which as we have seen is a small allowance for a temperature of 96°, would make short work with two feet in the reservoir, and this is the greatest addition which could reasonably be expected from the ordinary rainfall of the winter months.

It will be readily admitted that in estimating the available discharge of a river for the supply of a large city, it is necessary to take a low average, instead of the mean for a number of years, because it is essential to know what amount can really be depended upon for each year, as the water supply of a city should be placed beyond the reach of casualties.

The late Mr. Blackburn was fully impressed with the importance of this principle, hence he assumed his measurement of 5,000 gallons per minute in December as a reliable average.

My own estimate, on the same principle, is 5,833 gallons per minute, allowing two-thirds of increase for the three winter months; but this again is reduced by 900 gallons, which I allow as a minimum, and very scanty supply for the inhabitants of the district. The available discharge is, therefore, 4,933 gallons per minute, independent of the floods, or six feet seven inches in the reservoir.

I do not say that the discharge does not frequently exceed this; but I am strongly of opinion that in some seasons it does not do so.

I shall now, however, consider what may be regarded as the highest average, and I shall deduce the amount from the sectional measurements of the river.

It may be considered as an axiom, that when a river has defined banks, these indicate its ordinary limits, which it only exceeds in time of floods. In other words, every river may be regarded as having excavated for itself a bed sufficiently large to hold its ordinary stream. The ordinary stream, therefore, will be confined within the ordinary banks, and the highest average in the winter, unless in floods, will not overflow the banks.

Let us examine the sections of the bed of the river at the entrance of the aqueduct. The mean of the sections gives 28 feet within the banks, and 13·2 feet under the water line. Therefore, with the same velocity of half a mile per hour, the section could contain no more than 5,381 gallons per minute, without flooding the right bank. With double the volume, the velocity would not be increased, according to the usual formulæ, by one half. Therefore, I consider it to be demonstrated, that 8,071 gallons per minute, or three times the January measurement, is the highest discharge of the river, except in floods; and it is exceedingly rare to find any river in Australia level with its banks for six months in the year.

This discharge will give five feet four and a half inches in the reservoir for the six winter months; but it will be observed that it does not include the amount at present lost in the swamps, which I have calculated at 1,830 gallons per minute for the whole year, or two feet five inches in the reservoir.

The loss in January, as we have seen, is 3,253 gallons per minute, or at the rate of four feet four inches in the reservoir.

This estimate is of great importance, as showing the exact amount that may be saved by effectually withdrawing the tributaries from the evaporation, and it may be absorption, of the swamps.

If the two feet five inches, therefore, can be saved, it may be added to the five feet four and a half inches.

The highest ordinary discharge may be computed thus—the six summer months being taken at 2,537 gallons per minute, or three feet four inches, as measured by the committee in January.

	ft.	in.
Six summer months - - - -	1	8
Six winter months - - - -	5	4½
Amount lost in swamps - - -	2	5
Total - - - -	9	5½
Deduct 900 gallons for district - - -	1	2
Highest discharge of river - - -	8	3½
First estimate - - - - -	6	7
Balance in favour of 2nd estimate - -	1	8½

Thus my first estimate amounted to six feet seven inches as the ordinary discharge of the river, so that this second or highest estimate has an advantage of one foot eight and a half inches over the first. It will therefore be seen that, even allowing the river to be level with its banks for six months in the year, for which we have no measurements to guide us, still the result is very little more favourable than the first, and cannot with any certainty be depended on; and if one-third of the whole, instead of the scanty allowance of 900 gallons per minute, were left for the use of the district, this highest average discharge would be reduced below my former estimate.

The Committee, who were appointed by the Society to investigate the subject in a scientific manner, have arrived at results very different from my own. They do not base their conclusions on the measurements at all, which they profess to disregard, but on theoretical principles, and on certain calculations quite original, and apparently adapted to supply any amount of water that may be required in this dry climate; and they have determined that the discharge is three times greater than my estimate of eight feet.

Thus, although Mr. Blackburn, who was ignorant of the enormous evaporation in this colony, supposing it to be about three feet, only calculated upon a certain supply for 150,000 individuals, they, admitting nine feet of evaporation, which is equal to an annual loss of water that would supply 327,000 at thirty gallons per head per day, find that there is still sufficient left for a population of 666,000, and very generously leaving one half of this enormous amount for the use of the district, they regard the reservoir scheme as adequate to supply 333,000. Had Mr. Blackburn been spared, how rejoiced he would have been to find his favourite scheme so singularly developed in so short a time. This appears to be another illustration of the wonderful powers of unlimited extension attributed to the Yan Yean scheme.

The proportion of the Committee's estimate would stand thus: 3,000 gallons per minute for the six summer months, 15,000 gallons per minute for three of the winter months, and 48,000 gallons per minute for the other three winter months.

These large amounts are of course intended to include floods, but as I have elsewhere shown that in some seasons we may have no floods at all, and that the very highest flood, supposing it to last seventy-two hours, would only amount to three feet in the reservoir, or less than one-eighth of the whole, the above figures may be regarded as substantially correct.

It is a source of great regret to me that my estimate is so much at variance with that of the Committee appointed by the Society, but a thorough conviction that they are in error compels me to call in question the result of their investigations, and to discuss at some length their mode of reasoning on the subject.

And here it is necessary to state that the Committee at present consists of only two members, Mr. Christy, civil engineer, and Mr. Acheson of the Survey Department.

As originally appointed, the Committee contained the names of Mr. Wekey, the honorary secretary of the Society, and Mr. Hodgkinson, of the Survey Department, who, from his great practical knowledge, and long experience in the colony, and having already devoted much attention to the whole subject of the water supply of the city, was peculiarly fitted to aid their labours.

The former withdrew on finding, after mature deliberation, that he could not reconcile his own opinions and calculations with those of his colleagues.

The latter writes to the Society, "that although precluded, from want of time, from affording his assistance in the calculations of the Committee, yet, if he could have agreed with the conclusions arrived at by them, he would have appended his name to their report, but he differed very materially from some of their views."

It is much to be regretted, that the Committee thus lost the co-operation of two of the members, and especially on the grounds above stated, as it is evident, that they, as originally constituted, would have arrived at very different conclusions, and although I entertain the highest opinion of the professional abilities of Messrs. Christy and Acheson, I have to state, on public grounds, that however competent they may be to draw up a report on the watershed of English rivers, with the aid of English tables, they cannot be supposed to have much practical knowledge of the rivers of this country, from their comparatively short colonial experience, and they have never actually seen the river Plenty in the winter months, although their calculations show that they expect nine-tenths of the whole supply from the winter rains. The report, therefore, has lost much of that practical value that would otherwise have attached to any document emanating from a Committee of the Philosophical Society.

Finding such an enormous difference between my estimate of the watershed of the Plenty basin, and that arrived at by the Committee, Mr. Hodgkinson was induced to read a very interesting and valuable paper on the subject before the Society; and the result at which he has arrived strongly corroborates all my calculations and conclusions with respect to the watershed, which is the fulcrum upon which the sufficiency of the supply for a rapidly increasing population will depend. At forty gallons, per head, per day, Mr. Hodgkinson calculates that there will be water for 190,000, so long as there is no drought like that of 1837-38; in such a contingency he thinks the supply of water would fail.

But, it is to be noticed, that this estimate for 190,000 is based on a very important consideration, about which there is at present some difference of opinion. He has taken measurements of the evaporation from a pond which supplies his house, and calculates that it does not amount to more than five feet six inches in the year. Dr. Davy, on the other hand, who is our highest meteorological authority, regards ten feet as the probable evaporation. Now, at forty gallons per head, the difference between these estimates of evaporation would supply 123,000; deduct this from 190,000, and we have 67,000 as Mr. Hodgkinson's estimate, according to this higher rate of evaporation.

My own estimate, deducting the same evaporation, would supply 43,000.

Regarding these estimates as mere approximations, it will thus be seen that the difference between Mr. Hodgkinson's and my own is very small, being equal to only ten inches in the reservoir.

Now, while the greatest importance is to be attached to Mr. Hodgkinson's estimate of the watershed of the Plenty, as it is founded on a thorough knowledge of the river, and much practical experience both here and in England, I feel inclined to prefer Dr. Davy's estimate of the evaporation, and from measurements which I recently made on a larger sheet of water than Mr. Hodgkinson's pond, I found that in twenty-eight days the evaporation exactly equalled eleven inches, or 0·39 inches per day, which would give very nearly nine feet in twelve months.

But, after all, no scientific result can be obtained from ponds and waterholes, unless they are water-tight, which it is impossible to ascertain.

Thus, with Dr. Davy's lowest estimate of evaporation, Mr. Hodgkinson's estimate of the watershed would supply 94,000, so long as there are no droughts; but Dr. Davy gives us very little hope of escaping from such calamitous visitations.

Mr. Hodgkinson likewise expresses a very unfavourable opinion with respect to the quality of the water, when stored in the reservoir, and thinks that the Plenty is more likely to suffer deterioration from a resident population than the Yarra.

It is interesting and highly important in this inquiry to know that Mr. Hodgkinson's estimate of the watershed and my own are still further corroborated by the investigations of Dr. Davy.

He is not sufficiently acquainted with the geological character of the Plenty basin to give any exact estimate of the watershed, but, from observations and calculations which he has made respecting the force of evaporation from the surface of the ground, in this colony, he regards one-eighth of the rain, over any large area of surface, as the most that can reach the rivers, under any conditions of slope or geological formation, and he thinks that in many districts the proportion of rain that reaches the rivers is much less than one-eighth.

Thus, Mr. Hodgkinson, Dr. Davy, and myself, seem to have all arrived, by different and independent modes of investigation, at very nearly the same result. For all practical purposes, our different estimates will produce the same result.

I attach very little importance to the determination, on theoretical principles, of the watershed of the Plenty.

The only certain way, as stated above, of finding the amount, is to measure the streams at least once a month, in order to get the mean discharge for the year. But, if the aqueduct could be finished within the next two months, we should then have the very best means of practically testing how much water can be obtained from the winter rains.

I have availed myself of all the measurements already made, and without deducting the immense loss from evaporation in the swamps, have allowed an increase of two-thirds for the greater watershed of the winter months.

The members of the Committee have disregarded all these measurements, because they were taken in the summer months, and have calculated the amount of watershed, in accordance with the evaporation tables of Mr. Dempsey, which profess to show the evaporation due to the mean temperature of the different months in England, and I should have thought that it required no great amount of scientific knowledge to see that if these tables give a correct result for the mean temperature of England, they are totally inapplicable to the mean temperature of this colony, and would give a very incorrect result.

The Committee, in their report, admit that the evaporation from the surface of water is nine feet, which is nearly double the evaporation in England. It seems, therefore, a singular oversight on their part, not to see that the force of evaporation from the surface of the ground here must bear at least the same increased proportion, and, in point of fact, the evaporation is far greater than double.

That portion of the drainage area of the Plenty which is of the clay slate formation, and which may be estimated at fifteen square miles, or one-fourth of the whole, is so much more destitute of vegetation than the cultivated soil in England, that the surface of the ground becomes intensely heated under the influence of the solar rays and evaporation is exceedingly rapid.

Thus, the reasoning upon which the Committee rely, to account for their enormous watershed, is the same which has led all other scientific men to the very opposite conclusion.

If, according to their view, cultivation of the soil diminishes the rivers, England of all other countries ought to have the fewest and the smallest in proportion to the rainfall, and the extent of surface, whereas, it is exactly the reverse, and, in these respects Australia is the very antithesis of England.

A barren, uncultivated and impenetrable soil, absorbs no moisture from the atmosphere, and is very unfavourable for the deposition of dew.

Luxuriant vegetation absorbs large quantities of moisture during the day, and is most favourable for the deposition of dew in the night, and the surface, being protected from the direct rays of the sun, is always cool and moist, and the rain readily percolates through the soil to supply springs and rivers.

Mere surface water adds little to rivers, except in floods: it is that which percolates through the soil, and traverses either the superficial, or deep strata, that forms the principal and permanent supply of rivers.

A compact and impenetrable soil, such as the Committee believe to be most favourable for river supply, is in reality the worst adapted for that purpose, and it is only in the immediate vicinity of rivers that mere surface water can reach them.

The capillary attraction of the soil is too great to allow the rain water to travel over any extent of surface. The varying inclination of the surface also, and numerous other obstacles, oppose its motion.

Their illustration of the great watershed of the Dandenong ranges is worthy of notice. Because the surface soil is ankle deep with water in wet weather, they conclude that the watershed must be very abundant, whereas, the opposite conclusion is the more legitimate deduction. The rain, which is so firmly held in the surface soil as to convert it into swampy or boggy ground, cannot reach the rivers at all. It remains there only to be evaporated and lost. It is the geological formation of the ranges, and the close structure of the granite rocks, which prevents the rain from draining through the soil, and gives rise to swampy and marshy ground, even on the sides and summits of the mountain, and the same condition occurs in the slate formation, as for example in the swamps above Yan Yean, where the water cannot readily percolate through the fissures, or where there is a subsoil of heavy stiff clay.

Mr. Dempsey, himself, entertains the same views on this subject as I have now expressed, and thus the favourite authority of the Committee would be the first to detect their illogical reasoning, and he would be especially astonished, that on such reasoning they relied for justification of their unwarrantable adoption of his evaporation tables, to determine the very important question of the watershed of the Plenty basin, with a totally different temperature from that of England.

I have said that about one-fourth of the drainage area of the Plenty is clay slate, and I may add the whole of that of the reservoir, and it is the opinion of Mr. Blandowski, who has made a careful geological survey of the whole colony, that the clay slate formation is entirely destitute of rivers.

The rain water quickly disappears through the surface soil, which is composed of the detritus of the slate, and is lost chiefly by evaporation from the surface, which becomes intensely heated by the solar rays, and partly by absorption through the seams and fissures of the strata, to re-appear as springs, at some lower level, either in the ocean or in the beds of rivers; or, as frequently happens, in the waterholes of the dry creeks and watercourses which have no other permanent supply in the summer months; and this circumstance has led some to entertain very false notions with regard to the evaporation from the surface of water in this colony. Finding that their waterholes, on which they depend for their domestic consumption, suffer little diminution in the heat of summer, they conclude that the evaporation is very trifling.

Artificial waterholes, sunk in any locality, where the close structure of the underlying rocks prevents the escape of the surface water, will lead to the same erroneous conclusions.

With scarcely any exception, the slate strata are vertical, running north and south. Hence, they present the most favourable condition for absorption; and it is very common to find rivers originating in the granite formation, gradually losing themselves in the districts of the slate formation.

I have said that the Committee have calculated the amount of watershed, in accordance with Mr. Dempsey's tables. I do not say that their calculations are based on these tables; but, to use their own expression, they check their calculations with them. By a method which has never before been applied to determine the watershed of any other country, they find that 57·6 per cent. of the rain in the Plenty basin is evaporated, and 42·4 per cent. goes to the river, and then, in order to check this result, they consult Mr. Dempsey's tables, and find that exactly 57·6 per cent. of the rain in England is evaporated, and 42·4 per cent. goes to the rivers; and, forgetting that this colony is not England, and that our temperature is much higher, and that the evaporation from the surface of our uncultivated lands is vastly greater, they regard this coincidence as a proof of the correctness of their theory, and forthwith apply Mr. Dempsey's English evaporation to determine the discharge of the Plenty river in the winter months.

This extraordinary coincidence between their calculations and Mr. Dempsey's tables, even to a decimal fraction, might at first sight, be supposed to prove the mathematical accuracy of both, but a mere coincidence is not to be regarded as a proof of the correctness of either, it is necessary that one or other should first be established on a firm scientific basis before such a coincidence could prove anything at all. I shall not attempt to explain this singular coincidence, though, doubtless, it would form an interesting subject in an essay on probabilities.

I have already shown that Mr. Dempsey's tables give three times the amount of watershed that Dr. Thomson calculated for Great Britain, and I am prepared to show that they give a very erroneous and incorrect result of the proportion of the rain that is evaporated here, for, when corrected for the difference of temperature, they give only one-fourth of the watershed calculated by the Committee, and therefore the data upon which they rely to check their own calculations will prove that they are altogether unworthy of confidence, and must be divided by four to give a truthful result.

It appears, from the report, that the Committee chiefly rely on the eastern arm of the Plenty, for the supply of the reservoir.

Taking their own measurements in January, as the summer discharge, although, in consequence of rain, it considerably exceeded Mr. Blackburn's measurement in December, with a velocity of one and one-third mile per hour, it only gives 4,450 gallons per minute, which for the six summer months is equal to three feet in the reservoir; their whole discharge for the Plenty they calculate at twenty-four feet eight inches in the reservoir, therefore the winter discharge for six months will be eight times the amount of the summer discharge; but the section of the river will only contain three times the volume, supposing the stream to be level with the banks, with the same velocity, and they do not calculate for an increased velocity, as, according to the usual formulæ it would be very small or difficult to compute.

It is thus very important to notice that they assume the six winter months discharge at eight times the amount of the six summer months, while the river, when level with its banks, can only contain three times the amount.

They also assume that the river is really level with its banks, although they have never seen it in the winter months; but they are quite satisfied on this point from the evidence of a resident farmer.

This, it will be observed, is not very scientific or reliable evidence to check their calculations, or to justify the expenditure of £650,000 of public money, and accordingly the farmer's son, an intelligent lad of nineteen, in his father's absence, told Mr. Wekey and Mr. George Wilkie, that the river was only half full during the winter months, except in floods, which, with the same velocity, exactly accords with my own estimate of the winter discharge.

The principle upon which Mr. Dempsey's tables are based is precisely the same as that adopted by Dr. Dalton and Dr. Thomson, for ascertaining the watershed. He calculated that 57·6 per cent. of the rain is evaporated, and 42·4 remains to supply springs and rivers.

Whether Mr. Dempsey's tables are the result of his own experiments, or those of others, he does not say, but he clearly states that the evaporation mainly depends upon the temperature, heat promoting it, cold retarding it, and therefore I cannot conceive that he would commit such an egregious blunder as to apply his tables, without correction for the great difference of temperature, to determine the proportion of the rain evaporated in this colony.

In calculating the evaporation from the surface of water here from English tables, I assumed for each month the evaporation of a corresponding month in England, with the same or a less mean temperature, and I thus obtained eight feet two inches, which is sufficiently near to Dr. Davy's estimate of nine feet to show the correctness of the method.

I therefore hold it to be scientifically correct to adopt the same method with Mr. Dempsey's tables in order to determine the proportion of rain that is evaporated from the ground.

I have drawn up three tables for the purpose of illustrating the contrast between the proportion of rain evaporated here and in England, allowing the same proportion to the same mean temperature in both countries, and the result is 2·51 inches, or one-twelfth as the proportion of the rain that reaches the rivers in this colony.

TABLE I.—Showing the Mean Rain, and the Mean Temperature, and the Proportion of Rain evaporated in the different months in England, according to Mr. Dempsey :—

	MEAN RAIN.	MEAN TEMP.	EVAPORATION.	
	Inches.	Degrees.	Per cent.	Inches.
January	1·847	36·1	29·3	0·540
February	1·971	38 0	21·6	0·424
March	1·617	43·9	33·4	0·540
April	1·456	49·9	79·0	1·150
May	1·856	54·0	94·2	1·748
June	2·213	58·7	98·3	2·174
July	2·287	61·0	98·2	2·245
August	2·427	61·6	98·6	2·391
September	2·639	57·8	80·1	2·270
October	2·823	48·9	50·5	1·423
November	3·837	42·9	15·1	0·579
December	1·641	39·3	04·3	0·164
Total rain	26·616		Total evaporated	17·648

TABLE II.—Showing the Mean Rain and the Mean Temperature of the different months in Victoria, and the Proportion of the Rain evaporated, allowing the same per centage to the same Mean Temperature in both countries :—

	MEAN RAIN.	MEAN TEMP.	EVAPORATION.	
	Inches.	Degrees.	Per cent.	Inches.
January	1·36	67·94	98·6	1·34
February	0·95	67·31	98·6	0·93
March	1·60	63·92	98·6	1·57
April	3·13	60·56	98·3	3·07
May	3·67	54·91	94·2	3·45
June	2·41	51·00	79·0	1·90
July	2·18	49·34	79·0	1·71
August	3·61	50·66	79·0	2·85
September	3·27	55·08	94·2	3·08
October	2·59	58·97	98·3	2·36
November	4·27	62·25	98·6	4·21
December	1·86	66·29	98·6	1·83
Total	30·81		Total evaporated	28·30

Table III.—Showing the Mean Rain and the amount of Rain evaporated, and the Watershed, or that portion of the Rain that escapes evaporation in Victoria, deduced from Mr. Dempsey's Tables:—

	MEAN RAIN.	EVAPORATION.	WATERSHED.
January .	1·36	1·34	0·02
February .	0·95	0·93	0·02
March . .	1·60	1·57	0·03
April . .	3·13	3·07	0·06
May . .	3·67	3·45	0·22
June . .	2·41	1·90	0·51
July . .	2·18	1·71	0·47
August . .	3·61	2·85	0·76
September .	3·27	3·08	0·19
October .	2·54	2·36	0·18
November .	4·27	4·21	0·06
December .	1·86	1·83	0·03
Total	30·85	28·30	2·51

In illustration of this method I shall take our month of January, which has a mean temperature of 67° 94. On referring to Mr. Dempsey's tables I find that August in England has a mean temperature of 61° 6. Now, what can be more just or more in accordance with scientific accuracy, than to conclude that the proportion of the rain evaporated in our January is at least as great as that in the August of England?

In the same way I shall take our July, which has a mean temperature of 49° 34, and I find that April in England has a mean temperature of 49° 9. Am I not then warranted on scientific grounds to assume that the proportion of the rain evaporated here in July is equal to that of April in England? Now it is precisely in this way that I have deduced from Mr. Dempsey's tables that 2·51 inches, or one-twelfth of the rainfall adopted by the Committee, represents the proportion that reaches the Plenty.

I do not insist that Mr. Dempsey's tables are correct; but if they are so, then it would appear that the watershed of the Plenty is much less than I made it. His tables give 2·51 inches; I estimated 4·50 inches as the nearest approximation, and there is a vast difference between 2·51 inches and 10·69 inches when multiplied by sixty square miles of surface; and this is the watershed adopted by your Committee for eight months of the year. And as every point is of importance in this inquiry, it may be asked why the Committee allow no watershed for the four summer months; their own reason is, that they think there is none; this admission, therefore, is not to be regarded as a set-off for their assuming 10·69 inches as the watershed of the eight months.

According to Mr. Dempsey's tables, the proportion of the rain that reaches the rivers in the four summer months in England is equal only to one-fifth of an inch. Now, without any correction for the higher mean temperature here, one-fifth of an inch for our four summer months is too trifling to be noticed.

This extraordinary error of the Committee in their misapplication of Mr. Dempsey's tables, leads, as might be expected, to very extraordinary results, and it is necessary to follow out their reasoning to its legitimate conclusion.

Above Yan Yean, in January, the river gave three feet four inches in the reservoir in twelve months, and one foot one and a third inches in four months, or two feet two and two-third inches in eight months. The whole rainfall for twelve months, at thirty-one inches, is 68·2 feet in the reservoir. Deduct the rain for the four summer months, which is equal to 5·77 inches, or twelve feet six inches in the reservoir, and we have fifty-five feet eight inches as the rainfall of eight winter months. Take 42·4 per cent. of this which gives twenty-three and a half feet in the reservoir as the watershed of the Plenty in eight winter months, according to the calculations of the Committee. Add to this one foot two inches, or one-third of three feet four inches, to represent the discharge of the river for four summer months, and we have twenty-four feet eight inches as the total amount that comes down the river.

Of this enormous amount of water, they generously propose to bestow one-half on the district, which will be sufficient, as we shall presently see, to flood the river during the whole year, and may therefore prove a source of great inconvenience to the inhabitants. And it is their intention to appropriate the other half for the reservoir.

Their calculations may be represented as follows:—

	Ft.	In.
From the river during eight months -	23	6
Do. four summer months -	1	2
Total - - -	24	8

	Ft.	In.
Total - - - -	24	8
Deduct one-half for district - - -	12	4
Balance for reservoir - - -	12	4
Rain in reservoir - - - -	2	7
42·4 per cent. of rain over drainage area of ditto - -	2	4
Total in reservoir - - - -	17	3
Deduct evaporation - - - -	9	0
Total for the use of the city - -	8	3

This amount will exactly supply, at thirty gallons per head, 333,000; at 100 gallons per head, 100,000.

Now, let us contrast twenty-three feet six inches, with two feet two and two-third inches, the discharge for eight months according to the measurement of the Committee. Thus they make the Plenty for the eight winter months contain ten times the volume of water that it does in January, or, according to Mr. Blackburn's measurement, in December.

It will perhaps be said that this actually takes place in the Merri Creek; but such reasoning, if it proves anything, proves too much. This creek is not a river, and only runs after wet weather, and does not always run in winter; or the stream is so small that it can scarcely be said to run in very dry winters. After a heavy fall of rain, the creek is flooded for two or three days, but if the flood water were divided over 365 days, it would be a miserably small amount.

If any argument could be extracted from this, it would prove that, because the Merri Creek is at one season many million times larger than it is at another, therefore the Plenty may be so also, which is absurd; besides, this sort of reasoning has its inconveniences as well as its advantages. If we take the highest flood in the Plenty, and reduce it by a few million times, it would cease running altogether like the Merri Creek, and the City would stand a poor chance of a permanent supply of water from this source.

Perhaps it may be thought that the Yarra is an analagous case, and if it can be shown that it contains ten times the volume of water during the eight winter months that it does in December, so may the Plenty. The Yarra differs in many essential points from the Plenty, and chiefly in this important particular, that it takes its rise in very high mountains compared with Mount Disappointment, and these are covered with snow during the winter months. But it has yet to be proved that the Yarra undergoes so remarkable an increase in volume for a period of eight months in the year. This river has an average depth of thirty feet, for a distance of two miles above Prince's Bridge, and I need scarcely say that it only overflows its banks in floods, which may not occur once in two years. Its level, in the beginning of December, is not more than two or three feet below the average of the winter months, or below the level of many portions of the banks; with any reasonable increase in the velocity, therefore, how is it possible for the Yarra, with an increase of only one-tenth in its depth or sectional measurement, to carry ten times the volume of water for eight months?

We have only then to compare, in the drawings furnished by the Committee, the sectional area of the Plenty, at one or more points, in order to see how impossible it is to believe that the river, during eight months of the year, could contain ten times the volume of water that it does in December. The drawings show that the stream occupies in January one-half of the sectional measurement, that is, one-half of the depth where the banks are perpendicular.

Now, as above stated, it may be regarded as an axiom, that when a river has defined banks these indicate its ordinary limits, which it only exceeds in time of floods. Thus, without actual measurements for the winter months, important information as to the volume of water may be gathered from those that are resident on the spot. Dr. M'Kenna and myself put the question to Mr. Bear, who has long resided on his own property at Yan Yean, if a measurement of the Plenty, on the 12th of December, would give a fair average for the year. He replied, that he thought it would. Now, the meteorological tables show that November is our wettest month, and Mr. Blackburn's measurement of 2,700 gallons per minute was taken in December; therefore, it is not unreasonable to suppose, that Mr. Bear's opinion may be very nearly correct.

But let us examine the section of the river, at the entrance of the aqueduct, not very far distant from Mr. Bear's house. With a discharge in January of 2,537 gallons per minute, and a velocity of half a mile per hour, the section could not contain more than twice the present volume, with the same velocity, without spreading widely over its right bank, which is nearly level. With double the volume the velocity would be very little increased. Thus the section could not carry three times its present volume without flooding its right bank.

Such a state of things could scarcely escape the notice of an intelligent resident gentleman, if it were to go on for eight months in every year, and yet the Committee of the Society tell us that there is not only three times but ten times the above measurement during eight months in the year. Nor is there the slightest water-worn appearance on the banks to indicate that they form the ordinary channel of the river for any portion of the year.

I cannot at present furnish, on reliable authority, the average increase of rivers in floods; besides, this increase must bear a constant relation to the rainfall, and therefore to the latitude.

The Committee entertain the opinion that, during the eight winter months, the rain falls very heavily here, and that, in consequence, the watershed is very great. I am not aware of this fact, but, on the contrary, during the four summer months, when they say there is no watershed, we have sometimes, in consequence of the tropical heat, very sudden and tropical rains.

The increase of our Australian rivers during floods probably ranges from 50 to 100 times the volume of the ordinary streams, and this accords with the opinion of Mr. Blandowski, who possesses a great practical knowledge of the physical peculiarities of the colony. The highest flood lines of the Plenty, with the velocity assumed by the Committee of two-and-a-half miles per hour, give seventy-five times the volume of water that passes Yan Yean in December.

How very difficult is the result of their singular and elaborate calculations. Having found according to these, aided by the evaporation tables of Mr. Dempsey, that the ordinary stream of the Plenty for eight months out of the twelve, is ten times larger than it is in December, the highest flood lines which they themselves could discover will only permit of a remarkably small increase during floods, the greatest being seven-and-a-half times the volume of the ordinary stream.

Such a result is so startling and incredible, that it is sufficient, in my opinion, to warrant the rejection, by the Philosophical Society, both of their calculations and Mr. Dempsey's tables.

Nor is this result more incredible than that the ordinary stream of the Plenty is not confined within its ordinary banks, but for eight months of the year is widely extended over their level surface; a condition of things which was never witnessed by any of the settlers or residents on the river with whom I have conversed.

How much better would it have been for the Committee of a Philosophical Society to have disregarded theory altogether, and to have rigidly adhered to their own measurements, as well as those of Mr. Blackburn and Mr. Hodgkinson, and to have made these the basis of their calculations.

Theory, based upon experiments conducted in this colony, would possess a scientific interest and value, but otherwise it is practically valueless.

Speculative philosophers, who embark in abstruse scientific investigations with incorrect or inapplicable data for their guide, will soon find themselves lost in a pathless ocean, without a compass and without a chart.

Dr. Prout, one of the ablest writers on Meteorology, thus expresses himself with reference to the different estimates that have been made of the watershed of England:—

> These statements of the water that is condensed and evaporated in Great Britain, can only be viewed as rude approximations; and even admitting them to be correct, they could scarcely be applied with any advantage to an inquiry into the actual condensation and evaporation in other countries or climates, which in all instances must be determined by observation and experiment.

Before taking leave of Mr. Dempsey, I wish to state my entire concurrence in the liberal views he expresses with reference to the amount of water required for a city of 100,000 inhabitants.

Although, he says, twenty gallons per head might be sufficient for domestic and manufacturing purposes, and for the extinction of fires, yet he advocates a constant service of thirty gallons per head, and is of opinion that extravagance in water should always be permitted; and for the purpose of cleansing and watering the streets and thoroughfares, for the supply of fountains, public gardens, and pleasure grounds, and other miscellaneous and occasional purposes, he considers that one-tenth of an inch per day, should be allowed for the whole area. Part of this is supplied from rain, so that for a city covering one thousand acres, he allows fifteen gallons per head additional, making in all forty-five gallons, and if he were consulted about the proper supply for Melbourne, he would allow thirty gallons instead of fifteen, as it covers more than two thousand acres; and as the evaporation from the surface is more than double that of England, I am satisfied that he would on this account allow another thirty gallons, or ninety gallons in all, and this is precisely what is frequently used in New York on the constant service principle.

The Committee, it appears, hold Mr. Dempsey in high estimation as an authority. I am surprised, therefore, that they do not follow him in his liberal views on the water supply of cities. They only allow thirty gallons, but if his views are correct, this amount will leave no water for the numerous important purposes which he enumerates; so that we shall have carefully to guard against any unnecessary waste in order that a little may be saved to allay the dust in our streets and thoroughfares.

When the object is to obtain a very large watershed from the Plenty basin, they adopt Mr. Dempsey's evaporation tables, which give nearly the highest theoretical estimate of the watershed for the mean temperature of England, or about three times the amount of Dr. Thomson's estimate, who was at least equally well qualified with Mr. Dempsey to prosecute any scientific investigation; but when the object is to make the most of the limited supply at Yan Yean, they forget Mr. Dempsey and his water-tables, and, knowing that New York frequently consumes ninety gallons per head, they tell us that Melbourne, which is nearly in the same latitude, and has much more need of a plentiful supply, ought only to have thirty gallons.

It is singularly illustrative of the peculiarities of this reservoir scheme to glance at the results arrived at by the Committee.

At thirty gallons per head per day, one foot eleven inches in the reservoir will suffice for the city for twelve months. Taking their own estimate of the evaporation at nine feet, it will thus be necessary, in order to store and preserve one foot eleven inches for the city, to put into the reservoir each year ten feet eleven inches, or about six times the amount required.

Thus, for every gallon of water that will be consumed by the citizens for domestic purposes, and for watering the streets, five will be consumed by evaporation at Yan Yean.

The contents of the river Plenty represent that small fraction of the rain that nature has rescued for the use of man from the powerful influence of evaporation, under an

Australian sun. It does seem extraordinary, therefore, with so little to lose, that we should be solicitous, at an immense sacrifice of money, to provide an evaporating basin in the vicinity of the river, sufficiently large to swallow up nine-tenths of the small supply which nature has thus provided for our use.

I confess to have some impatience for the publication of the full report of the Committee, in order to learn what they recommend to be done with this evaporating basin. A few more such basins, of a size proportioned to our larger rivers, would effectually secure the loss of all our river water, and convert this beautiful province of Australia Felix into an Australian desert.

It may be said that, in commenting upon the opinions of the two civil engineers who form the Committee, it is very unlikely that I should be right, as such questions belong to engineering, and are therefore strictly professional. An attentive consideration of this paper, however, will show that there are no questions involved which any person of ordinary education may not clearly understand and appreciate; and therefore, simply as a member of the Philosophical Society, it is perfectly competent for me to call in question any novel methods of investigation adopted by the Committee, and to say whether, in my opinion, these are legitimate and scientific, or the reverse.

But the great and important points upon which the success or failure of the Yan Yean scheme depends do not belong more to the province of the civil engineer than to the medical profession.

I have heard of civil engineers bridging the Menai Straits with a stupendous tube of iron, and tunnelling the river Thames, and building a leviathan steam ship of 25,000 tons, to perform the voyage to Australia in thirty days; and if the Goulburn River and the King Parrot Creek are to be brought through granite mountains into the Yan Yean reservoir there are still higher and greater laurels in store for our colonial engineers. But I am not aware of any civil engineer who has published original researches on the subject of Heat and Evaporation. Hitherto this department of science has been chiefly cultivated by members of the medical profession.

I never heard of any civil engineer who had published original investigations on Meteorology. This subject also owes more to the medical profession than to the civil engineer.

I know of no civil engineer who has added anything to our knowledge of the watershed of different countries. Original experiments and observations on this subject have been principally contributed by medical men. Perhaps Mr. Dempsey may be cited as an exception; but I think the less that is said about his evaporation tables the better.

I need scarcely add that it is not to civil engineers, but to members of the medical profession that we owe all our knowledge of the impurities of water, and their injurious effects on health, as well as the best and most effectual means of removing and counteracting them. And we are especially indebted to Dr. Hassall, of London, for his laborious microscopic examination of the impurities of all kinds that abound in the water that is supplied to the city.

Dr. Clarke, Professor of Chemistry in the Marischal College, Aberdeen, is acknowledged to be the highest authority in England, in all questions connected with the water supply of cities; and Dr. Smith, Professor of Chemistry in the University of Sydney, who for some years conducted all Dr. Clarke's practical investigations, is the highest authority on such questions in the Australian Colonies.

I think it will be admitted, therefore, that the scientific subjects considered in this paper come strictly within my own province, as a member of the medical profession, and that there is no reason why I should be disqualified to discuss them in a scientific manner; and I think I have sufficiently demonstrated, by legitimate reasoning, that the calculations of the Committee are not based on any correct or scientific data at all, but purely on speculations and assumptions of their own, and that the results to which they lead, when thoroughly investigated, are so incredible, as to carry with them their own condemnation.

In my estimate of the water available for the reservoir, I consider that ample justice has been done to all the sources of supply.

I have shown that, at the time of our late visit to Yan Yean, the whole discharge above the swamps was 5,790 gallons per minute, and, that of this amount, 3,253 gallons per minute were lost by evaporation in the swamps, or at the rate of four feet four inches in the reservoir; and I have taken for granted that effectual means will be adopted to prevent this loss, which, I have before stated, amounts to two feet five inches in the reservoir in twelve months. The total amount of supply for the reservoir I have estimated at eleven feet six and a half inches: so that, deducting two feet five inches, there will only remain nine feet one and a half inch, or just sufficient to cover the evaporation from the surface.

In the meantime, therefore, until such means are adopted, it may safely be asserted, that there will be no water for the city at all: and it is rather a singular circumstance, that if we are to get any supply for the city, it must be by saving the two feet five inches that are at present lost by evaporation, and very probably also by absorption in the swamps, and if this can be done, there will be a supply for 71,500, at forty gallons per head per day.

To bring both arms of the Plenty to Yan Yean, clear of all loss from the swamps, would be a very difficult undertaking. The swamps are only to be likened to large sponges, and simply to cut a watercourse through them, and lower their level, would have very little effect in withdrawing the stream from their influence.

The evaporation would continue nearly the same, and would be fed from the current. The eastern swamps are about three miles in length, the western five miles; and I am strongly of opinion, that the loss from evaporation and absorption, could be saved in no other way than by conveying both branches in iron pipes.

Mr. Christy has kindly favored me with an estimate of the cost of laying suitable pipes for this purpose, which would amount to £14,000 per mile, or to £42,000 for the eastern branch, and £74,000 for the western. So that, after all, it may become a grave question, whether it be really worth while to go to any expense at all to save either branch from the evaporation of the swamps.

I have also taken for granted that we shall have sixty hours of floods each year at Yan Yean, while it is not unusual to have no floods at all; and I have allowed an increase in the Plenty of two-thirds, during the three winter months, for rain; although we sometimes, as last year, have very little rain in winter, and I have allowed a rainfall of thirty-six inches for the reservoir, although it is very doubtful whether there really is that average at Yan Yean. And, I may well ask, what became of the thirty-six inches of rainfall in 1851? I have no doubt that there is a larger and more constant rainfall at the Dandenong Ranges; but they are much nearer the Bay than Mount Disappointment, and therefore attract and intercept the rain-clouds, and it is well known that there is a greater rainfall near the coast than further in-land. This is well exemplified in Melbourne, where we have many showers of rain which do not extend ten miles out of town.

I have allowed four inches for dew over the whole basin of the Plenty, an amount of water which would give eight feet eight inches in the reservoir; although it is very probable, in this dry climate; that there may not be two inches; and I have allowed two inches for the reservoir, without any scientific data to show that dew would be deposited at all; and, from an estimate which I have made of the whole watershed of the Plenty, based on scientific data, it appears that I have given the reservoir the advantage of nearly the whole amount.

And, what is of greater importance than all else, I have deducted nothing from the supply of ordinary seasons on account of droughts, of which we have had ample and painful experience in other parts of Australia; and a gentleman, who has recently returned from Adelaide, has told me that they have scarcely had any rain there for the last eighteen months.

I must not omit to mention here, that it is intended to have two intermediate reservoirs betwixt Melbourne and Yan Yean,—the one at Pentridge, the other near the Plough Inn. Your Committee requested information respecting their extent of surface, with a view to determine the amount of loss from evaporation, but they were refused all information on the subject. I have, therefore, been unable in my estimate to make the necessary deduction for their evaporation.

I shall only further add, in support of my statement that ample justice has been done to all the sources of supply, that while I place implicit confidence in Mr. Hodgkinson's opinion respecting the retentive nature of the bottom of the reservoir, there are not wanting others, who have had great experience in this colony, who think that the chances are very great indeed that in some parts of the vast extent of the reservoir, the water will find its way through the fissures of the clay slate to a lower level. I need not say there is no remedy in such a case. £2,000,000 would not suffice to puddle a surface of 7,000,000 square yards.

When this scheme was first proposed, I felt astonished to think that the Plenty could supply so much water as was alleged. I imagined, however, that the deficiency might probably be made up by the winter rains over an extensive district. And although I considered this a very objectionable source, I entertained the hope, that with a depth of 25 feet, and a current established through the reservoir by means of the river, and with a perfect system of filtration, the water might be rendered comparatively pure, and that its inferiority might, to a certain extent, be compensated for by its superabundance.

It was only lately, in consequence of my visit to Yan Yean in company with Dr. Mackenna, that I was enabled to obtain the information necessary to arrive at more correct conclusions, and our astonishment and surprise can be better imagined than described, when we compared the diminutive stream of the Plenty with the wide extent of the reservoir intended for its reception; and, indeed, while contemplating from one of the heights the grandeur and singular beauty of this vast plain, the conviction forced itself upon our minds that the whole volume of the river would not suffice during the heat of summer, to wet the surface; and this my subsequent investigations have proved to be literally true.

The evaporation from the surface of the reservoir is equal to one foot per month for the three summer months. Now, the river, at the entrance of the aqueduct, gave 2,537 gallons per minute in January, or three feet four inches in twelve months; and this is above the average for the summer months, as Mr. Blackburn, in the dry summer of 1851, found it reduced in February to 865 gallons per minute, or to nearly one-third. Let us, however, take three feet to represent the discharge; this would give three inches for each of the summer months. Thus, with twelve inches of evaporation, it would take four rivers equal in size to the Plenty, to keep the reservoir wet. And if we take Mr. Blackburn's lowest measurement of 865 gallons per minute, it would require exactly eleven such rivers to give even an appearance of moisture to the surface of the reservoir.

According to the data which I have submitted to you, there is no difficulty in predicting the complete failure of the Yan Yean Waterworks for want of water; and it is important to notice here, that the amount of water in the reservoir, after deducting the evaporation, is far short of the amount that seems confidently to have been calculated upon. Two feet six and half inches, as measured for the whole surface, would give six feet of depth at the lower end, and this is the very lowest point at which it would be practicable to draw off the water. Below this point I consider that it would be altogether unfit for use, and it has never been contemplated to draw it off at so low a level for the use of the City, as the main pipes are intended to be supplied through two openings in the Tower Well, at ten and seventeen feet from the bottom.

It also appears that the immense extent of the reservoir, which has always been regarded as its greatest advantage, is in reality so serious an evil as to involve the failure of the whole scheme.

It is quite clear that the difference between the amount of rain and evaporation will represent the amount of loss depending upon the wide extent of the surface exposed. This difference is six feet, and is equal to nearly twice the whole discharge of the river, as measured by your Committee, above Yan Yean, and is nearly equal to Mr. Blackburn's estimate of all the tributaries above the swamps. The whole amount thus lost by evaporation in the reservoir, or nine feet, being sufficient to supply a population of 245,500, at the rate of forty gallons per head per day, or 491,000 at twenty gallons, which is equal to a loss of 9,820,000 gallons of water per day.

With an unlimited supply of water this immense loss would have signified little, but when the sources of supply are so remarkably inadequate, the case presents a very different aspect.

The foregoing considerations afford no prospect whatever of success to the Yan Yean scheme with the existing sources of supply, but it has always been regarded as capable of indefinite extension from other sources. It becomes necessary, therefore, to consider this part of the subject, in order to ascertain how far it may be possible, or practicable, to supplement the reservoir, and thus render it equal to supply, not only the present wants of the City, but a large prospective increase of population.

For this purpose it has been proposed to bring the Merri Creek, the Diamond Creek, the King Parrot Creek, and even the Goulburn River itself, into the reservoir.

With regard to the Goulburn River, if it were practicable to bring it into the reservoir, by means of an aqueduct, and if the expense of such an undertaking would not be beyond the means of the colony, there cannot be a doubt that this would render the Yan Yean scheme eminently successful, and Melbourne might then boast of being better supplied on the gravitation principle than any other city in the world.

I feel incompetent to give an opinion in a case involving so many difficult questions, and that could only be determined by experienced engineers, after complete surveys of the intermediate country; but it appears to me, independently of the expense, which would be enormous, to be altogether chimerical. The great dividing granite ranges, which must have a very considerable elevation above the bed of the Goulburn, without mentioning other difficulties, would render such an amount of cutting and tunnelling necessary, that I fear the idea must be altogether abandoned.

Similar difficulties would attend the proposal to bring the King Parrot Creek, which is a tributary of the Goulburn, into the reservoir. The same dividing ranges would have to be tunnelled, and much broken country bridged by aqueducts; but a scientific survey by competent engineers could alone determine the question of its practicability and cost. And after all, would it be worth while to expend a very large sum in conveying so small a stream from so great a distance? Such a scheme, I apprehend, must be entirely laid aside until it is shown that there is no other cheaper plan of supplying the City with water.

The Diamond Creek claims our next consideration. It is a tributary of the Yarra, and, in its upper course, is not more than six miles distant from Yan Yean. It is more easy, therefore, to form an estimate of the probable cost of bringing this creek into the reservoir. An engineer, of great practical knowledge, assured me that he would not undertake the work for 50,000*l.* Besides, unfortunately it is a very diminutive stream, even compared with the Plenty; and, according to my judgment, is barely sufficient to supply the wants of the village of Eltham and the increasing population of this important district.

This proposal, therefore, merits no further notice.

It only remains to consider the Merri Creek as a source of supply, It rises in a swamp of 1,280 acres, which is said to have 30 square miles of drainage area, but there is not a single creek or watercourse of any description, leading into it, which shows the very small proportion of the rain that drains into it from an area of surface equal to one-half of the Plenty basin. It is proposed to dam up this marsh, and to lead the water by an aqueduct into the reservoir. Let us suppose, therefore, that this marsh really does receive the watershed of thirty square miles, the area of the swamp being two square miles, a rainfall of thirty inches would give a depth of thirty-seven feet six inches, and one-ninth, or four feet two inches would represent the watershed. This, added to the rainfall of the swamp, would give altogether six feet eight inches, which is not sufficient to cover the evaporation; and it would, therefore, be dry for two months in the year.

It is useless, therefore, to look to this marsh as a source of supply; and, even were it otherwise, I could never sanction the principle of robbing a thickly-settled district of the fountain-head on which they chiefly depend for their supply of water, which at best is very small in ordinary seasons.

So much importance has always been attached to the supposed facilities that existed for indefinitely extending the reservoir, when occasion should require, that I have thought it necessary to consider the subject under its different heads; and I think I have said enough to show that the Yan Yean scheme has nothing to hope for from the principle of indefinite extension; that, indeed, it cannot be extended at all.

I forget, however, that there is one direction in which it can be extended, and I owe it to Mr. Hodgkinson for pointing it out. He has given his attention to all the different methods proposed for extending the reservoir scheme, and he has come to the conclusion that by far the cheapest plan of doing so is by pumping from the Yarra; and I readily admit that there is no limit to the amount that may be obtained in this direction.

I have thus shown that the sources of supply for the Yan Yean Reservoir are insufficient to make up for the immense loss sustained from evaporation. I have also shown that there is no hope whatever of extending the resources of the reservoir in any direction, unless by pumping from the Yarra. I have also shown that if the two feet five inches that are now lost in the swamps could be saved, this would only supply 71,500, whereas we require a supply at present for at least 100,000.

I have also shown that the medical profession here are strongly opposed to the principle of storing water in a large swamp in this climate; and they entertain the worst fears that the pure waters of the Plenty will be rendered perfectly unfit for use by being transferred into the reservoir. And I may add, that while it is found necessary in England to clean out such reservoirs once in five years, on account of the immense quantities of decaying organic matters that accumulate in them, and render the water offensive and unwholesome, it will be utterly impossible to clean out the Yan Yean Reservoir. At 5s. per square yard, it would cost 1,750,000*l.*; and how would the city be supplied during the twelve months that would be required for cleaning and refilling the reservoir? It remains to be considered what steps are now to be adopted. It is quite clear that the reservoir must be abandoned altogether.

From the data which I have presented to you, it will be observed that there is a sufficient supply in the eastern arm of the Plenty for the present population of the city. The discharge of this main branch in January, was 4,450 gallons per minute, and deducting 630 gallons, which I have done to compensate for the previous heavy rains, and to assimilate the amount to Mr. Blackburn's estimate for ordinary seasons, we have 3,820 gallons per minute, which is equal to five feet one inch in the reservoir, and would, therefore, suffice for a population of 138,600, supposing the whole to be conveyed in iron pipes without loss. Here, then, is one source of supply, and the water is pure and unexceptionable.

But there are certain considerations of great moment connected with this source.

In a dry summer, such as that of 1851, the supply would, according to the measurements of Mr. Blackburn, be reduced by one-fifth, therefore this source can only be depended on to afford a constant supply for a population of 110,000. And, according to Mr. Blackburn and Mr. Hodgkinson, a drought of eight months, or of one year's duration would diminish it still further, if not dry it up altogether, as the western arm has been more than once.

Another very weighty consideration is, that the present stream of the Plenty is entirely dependent on the eastern branch for its supply, the western being evaporated and lost in the marshes. If this supply therefore is cut off, the Plenty will cease to run altogether, unless the western arm be conveyed for a distance of five miles clear of the swamps, which I fear will be found a difficult and expensive operation. It could be done without any loss by laying a thirty-six inch pipe; but the cost, according to Mr. Christy's estimate, would be 70,000*l.*

By adopting efficient means to save the western arm from evaporation, and to restore it to the natural channel below the swamps, the stream might be maintained, notwithstanding the appropriation of the eastern arm for the use of the City.

The Government and Legislative Council have therefore seriously to consider if it be right or proper that this rapidly increasing City should be dependent on a source which is only equal to supply a population of 138,500 in ordinary seasons, and 110,000 in very dry summers, and in severe droughts perhaps nothing at all. And it is very important to bear in mind, that if we are to pay for bringing water by gravitation from a distance of twenty-five miles, we are not necessarily restricted to the eastern arm of the Plenty, even supposing this source to be one on which we could at all times depend.

In the report of the Select Committee already referred to, I find that Mr. Blackburn, after a careful survey of the Yarra, ascertained that at a distance of twenty-five miles from Melbourne there is a sufficient head in the river to supply the City on the gravitation principle. Mr. Christy has kindly estimated for me the cost of laying a thirty-six inch pipe for a distance of twenty-five miles, and it amounts to the enormous sum of £369,900. If therefore we are to bring our water into the City from this great distance, I think it will not be denied that it is far better to leave the eastern arm of the Plenty altogether, and go at once to the Yarra, where we shall have as much water as a thirty-six inch pipe can deliver, which I have no doubt would suffice for a population of at least 500,000.

And it is also most important to bear in mind that a work of such magnitude would never have been thought of for a moment if it could have reached no further than the present wants of the City. The preference of the gravitation scheme was entirely based by the Commissioners on its supposed capability of supplying at least four times the present population of Melbourne, and on the facility with which it was believed that the works could at any time be indefinitely extended; and it was only very lately that Mr. Jackson, the engineer of the works, is reported to have made similar statements in a paper which he read before the Victorian Institute of Science. I shall take the liberty of quoting a paragraph from the newspaper report:—"The numerous advantages of the Yan Yean Reservoir Scheme were pointed out; several interesting particulars were stated in the paper. The Yan Yean scheme it appears can be extended indefinitely, without any addition to the reservoir, so as to supply Melbourne with water even if it attained the population of London. It was suggested that the cheapest plan of supplying Geelong might be from the same source which is intended to supply Melbourne."

It is foreign to my purpose to discuss, in this paper, the opinions which Mr. Jackson has published on the subjects of which I have treated; but, as it eminently concerns the public to know the kind of data upon which the Commissioners base their extraordinary expectations of success, I shall add a few illustrations of the scientific views entertained by their engineer.

Having disposed of Mr. Hodgkinson's pumping scheme, and all other plans for supplying Melbourne and Williamstown from the Yarra, as impracticable and absurd, Mr. Jackson considers that the Merri Creek swamp, were it not for its distance, would be a very eligible site for a store reservoir for the City; and says, that it receives the drainage of about thirty square miles.

He says, also, "the necessity of constructing a store reservoir would not be manifest to a casual observer, but, as it would appear from the evidence of those settlers who have been established on the banks of the River Plenty for the longest period of time, that at a ford known as the Bridge Inn Ford, the Plenty has been known, on several occasions, to cease to flow, the necessity becomes more obvious."

He further says, "I found that the Yan Yean reservoir would receive the drainage of eighteen square miles. (Mr. Hodgkinson's measurement is four and half square miles) an area which, in my belief, is sufficient in itself to afford an ample supply of water for the City, without looking to any other source; but, as droughts of two or three years' standing have been known to occur, I consider it advisable to lead in the Plenty River."

He further adds, "that the reservoir can be made to receive, in addition to the Plenty River, the drainage of upwards of 120 square miles of surface." The Survey maps give sixty square miles as the area of the Plenty basin.

It needs no additional arguments, as it appears to me, to show the great advantages which a Yarra gravitation scheme would possess over a gravitation scheme having the eastern arm of the Plenty as its only source of supply; but if these are wanted, they will be found in the fact that if we are to be satisfied with the supply of our present wants only, at the enormous cost of 369,900*l.*, and if we are to depend upon the eastern arm of the Plenty for this supply on the constant service principle, we have no guarantee whatever that our wants will really be supplied after all, or that the supply will be equal to the actual demand. At forty gallons per head per day, the eastern arm is no doubt fitted to supply 100,000 inhabitants, if we are prepared to chance the droughts; but it has been practically found that there is no way of limiting each individual to his forty gallons, if the distribution is on the constant service principle. And the Comissioners of Sewerage and Water Supply, backed by the opinion of the Select Committee, have, very properly, from the first, determined to supply the City on this principle, and it would be a sad retrogression in sanitary economy to revert to the antiquated method of intermittent supply, with its cumbrous machinery of dirty and ill-conditioned cisterns.

The constant-service principle, therefore, is not at all adapted for a limited supply of water, and this important fact has been clearly demonstrated by the experience of other cities. Croydon, which is supplied on this principle, consumes 500 gallons per house per day, which, making the usual allowance of five individuals to each house, is equal to 100 gallons per head instead of forty. Hitchin consumes 235 gallons per house, or forty-seven gallons per head. Whitehaven 250 gallons, or fifty gallons per head; and New York, which is nearly in the same latitude as Melbourne, and is therefore our best guide in regard to the amount that may probably be required, on some days consumes ninety gallons per head instead of forty.

At Rugby, Sandgate, and Barnard Castle, the supplies have been found inadequate from waste; and the Bristol company have been forced to abandon the constant-service principle altogether.

With such important facts before us, can we look with any confidence to a source which, under the most favourable circumstances, is only fitted to supply the present population of Melbourne, with its suburban towns and villages. And what is there so very repulsive in the Yarra that we should not at once resort to it for our water supply?

After giving my best attention to the whole subject, I would in the strongest manner recommend that we should abandon all hopes of supplying the City from any other source than the Yarra, where, at all times, and under all circumstances, we shall obtain an unlimited supply of the purest water.

I am aware that there is a very strong feeling on the part of the public that the works ought to be completed now, as the money is nearly all expended. But more mature consideration will show that if any confidence is to be placed in the estimates of Mr. Hodgkinson, Dr. Davy, and myself, the available amount of water, after deducting the evaporation, will not suffice even for the present wants of the City; and with so limited a supply, the water would be unfit for use, were it possible to run it into the pipes,

Where is the object, then, in laying twenty miles of pipes, even under existing contracts?

If the pipes had been laid, it might have been argued that it would be cheaper to carry them five miles further to the eastern arm, at an additional cost of 70,000*l.*, than to remove them to the Yarra. But the main pipes are not yet laid, except for a very short distance; and, therefore, I do not see that it is too late to lay them in another direction, where we shall find at all times the purest water in the most unlimited abundance.

But, while I am of opinion that the pipes ought not to be laid, I am most anxious that the capabilities of the reservoir should be tested before finally abandoning it; and, for this purpose, I hope that the aqueduct will be completed in time to take advantage of the winter rains.

I may also notice that no steps have yet been taken to convey the two branches of the river through the swamps. This will cost a very large sum, and of course is not yet contracted for.

It is deeply to be regretted that a work of such magnitude and importance as that which forms the subject of this paper should be found to be based on incorrect scientific principles; and it shows the vast importance of cultivating the sciences, even in this remote corner of the globe.

Had there been a scientific society in this city two years ago, the Commissioners might have obtained more correct information respecting the rate of evaporation in this colony, and more certain and reliable data with respect to the water-shed of the Plenty basin; which were so necessary to ensure the success of their scheme.

It was purely on scientific grounds that I was induced to undertake the investigation of this subject; and it was the conviction of its great importance, in a scientific as well as in a sanitary point of view, that has led me to submit to you the result of my inquiries.

If there is any probability of the Yan Yean Reservoir scheme failing for want of water, the sooner this unfortunate result is discovered the better.

It would surely add little to the scientific reputation of Victoria, that a work of such magnitude should be allowed to be completed, at a ruinous sacrifice of public money, before its failure is even suspected.

ART. XIII.—*The Meteorology of Melbourne. By* DR. E. DAVY.

MY attention during a part of the last four months having been directed to the meteorology of this place, I propose to lay before this Society the result of the observations I have